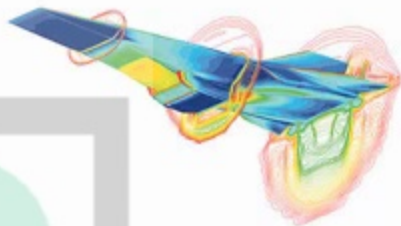
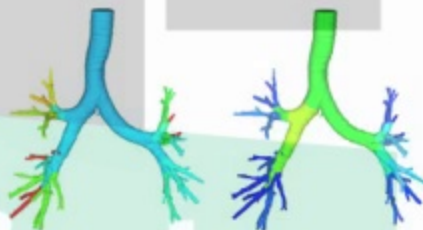


ME 702 Computational Fluid Dynamics, CFD

Prof. Lorena A. Barba
Spring 2012



Hyper-X at Mach 7, NASA
image in the public domain



Human airways,
by FuiDA nv



F1 car by Advantage CFD



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The Finite Volume method, FVM

► the most widely used method in CFD



— No requirements on the grid to be structured.

→ Very general, flexible

— It uses Integral Formulations of the Conservation Laws

— It is based on cell-averaged values

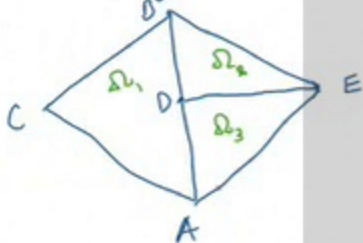
Discretization → Set of small cells : finite volumes

Advantage → a conservative discretization is automatically satisfied through direct use of Integral Conservation Laws

V the flow equations express Conservation Laws

Vizle differential form $\rightarrow$ fluxes need to be differentiable

General form of a Conservation Law : $\frac{\partial}{\partial t} \int_{\Omega} u d\Omega + \oint_S \vec{F} \cdot d\vec{S} = \int_{\Omega} Q d\Omega$
 *(only need surface values of fluxes)



Ω divided into $\Omega_1, \Omega_2, \Omega_3$

For each subvolume : $\vec{F} \cdot d\vec{S} = \int_{\Omega_i} Q d\Omega$
 $\frac{\partial}{\partial t} \int_{\Omega_1} u d\Omega + \oint_{ABCA} \vec{F} \cdot d\vec{S}$

$\frac{\partial}{\partial t} \int_{\Omega_2} u d\Omega + \oint_{BCDA} \vec{F} \cdot d\vec{S}$

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